CDF-Padova Group
Run II Analyses: From High-Pt to B-Physics

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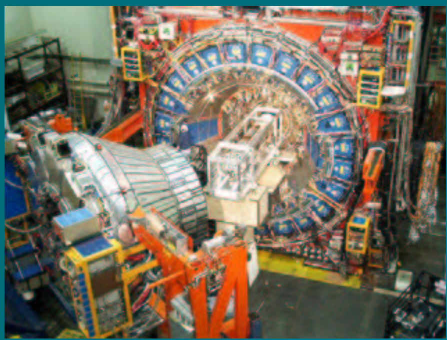
CDF-Padova Group is involved in several analyses ranging from High-Pt multijet and B physics.

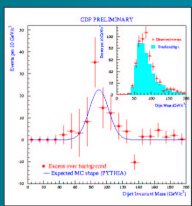


Current High-Pt Physics issues

$Z \to b\bar{b}$

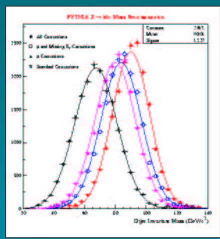
During Run I, the $Z \to b\bar{b}$ signal was isolated by means of events collected by a muon trigger. Events were selected by requiring:

- 2 jets with $E_T \geq 10\ GeV$ tagged as coming from a b-quark decay;
- $\Delta\phi_{jj} > 3\ rad$;
- $\Sigma_3 E_T < 10\ GeV$.



The amount of events, calculated by means of an unbinned two component fit was found to be 91 ± 30 (stat.) ± 16 (syst.).

The interest for this analysis during Run II rises from the possibility it offers with respect to the jet energy corrections and the energy scale determination for jet coming from b-quark decay.



During the Run I, Monte Carlo based energy corrections allowed to obtain a better resolution on the di-jet invariant mass spectra. The position of the Z peak and its width is shown in figure as a function of the jet energy corrections applied.

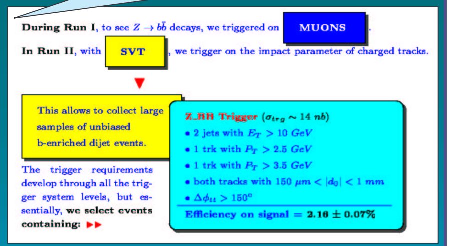
During Run II, the high statistics available will allow to study jet energy correction testing and tuning them starting directly from the signal peak.

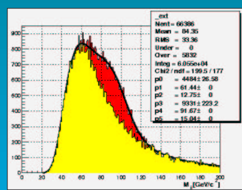
It is critical to exploit the peculiarity of the b-jet in term of energy correction. In fact, while a large amount of events with a jet or a photon recoiling against a leptonic Z boson allows to determine the energy scale for light quark jets, the situation is different for jets coming from b-quark decay. This is due to the very low cross section of processes with a b-jet recoiling against a photon or a Z and to the presence inside b-jets of lepton and neutrinos altering considerably the calorimetric response.

The know-how reached from the study of the signal we are interested in, could also be applied to other analyses involving the presence of b-jets in the final state as the associated Higgs production and the t-quark pair production.

In particular for Run II, new triggers allow a better discrimination of signal from background events.

A new silicon detector based trigger, SVT, allows the online selection of a heavy flavour sample by looking for tracks displaced from the primary vertex, exploiting in this way the long life time of b-quark.





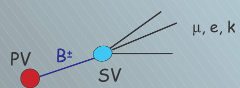
On the offline side, the b-jet tagging is to date under optmization but a development code is available to get first hint for analysis tools. The tagging algorithm looks for displaced tracks inside jets to reconstruct secondary vertices.

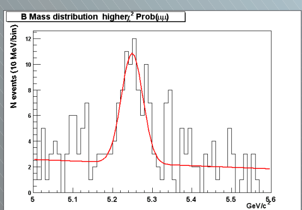
First data collected with the $Z \to b\bar{b}$ trigger, previously described, allows us to get some extrapolation on how, with the current trigger running conditions, will appear the di-jet invariant mass spectra. The figure shows the result of such extrapolation by means of a pseudoexperiment technique. The signal shape is obtained from Monte Carlo events, while the background one follows the single tag behavior. The amount of signal (in red) is determined on the base of trigger efficiency, collected luninosity and the expected cross section (1.2 nb).

Current B-Physics issues

$B_s \to D_s\pi$

The principal interest in Padova is to study the B_s physics. As a first step, we want to measure the branching ratio of the decay $B_s \to D_s\pi$ relative to $B_u \to J/\psi K$.

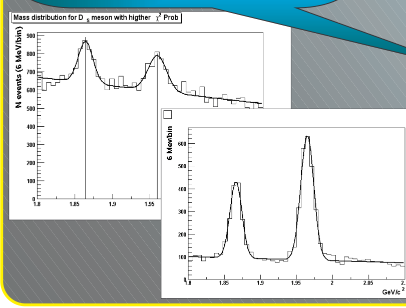


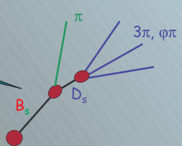


The $B_u \to J/\psi K$ decay is reconstructed in the same dataset used for the $B_s \to D_s\pi$, i.e. collected with SVT-based trigger at the aim of cancelling the trigger efficiency between the two processes.

A three prong candidate is reconstructed from tracks which pass standard quality selections like a minimum number of hits per track and a transverse momentum threshold. A constrained vertex fit is performed assuming for two tracks the muon mass and for the last one the Kaon mass. The invariant mass distribution obtained after other kinematical requirements, is fitted with a gaussian and a straight line. The number of signal events is found to be 58 ± 10. The result as shown in the figure on the left.

The B_s is reconstructed as a three prong tertiary vertex plus a pion coming from the secondary vertex. At the moment only $D_s \to \phi\pi$ with ϕ in KK and D_s in 3π have been reconstructed.





After kinematical selection similar to those applied to those in $B_u \to J/\psi K$.

we have about 2070 events for the first decay and about 1000 for the latter

The b-jet energy scale

The systematical error affecting the top mass measurement during Run I was dominated by the uncertainty on the energy scale of jets. *For a better determination of the top quark mass, we have no chance but a better determination of the energy scale.*

Systematics on M_t $[GeV/c^2]$	Run I	Run II
Jet energy scale	4.4	2.2
Signal Model	2.6	0.4
MC generators	0.1	0.1
Background model	1.3	0.3
b-tagging bias	0.4	0.4
P.D.F.	0.3	0.3
Total	5.3	2.3

The energy scale could be determined on a Monte Carlo based way, following the prescription:

- let us suppose to have the Z peak as shown in the extrapolation figure;
- try to describe the signal with different MC templates in which the jet energy is varied by means of multiplying by a scaling factor, we call jet energy scale factor.
- For each pseudoexperiment we can fit the mass spectra of the extrapolated data with the so obtained template for different values of the scaling factor, maintaining the same background shape.
- A two component fit is then performed with the Z mass and its width fixed to the MC template values. It returns its χ^2.

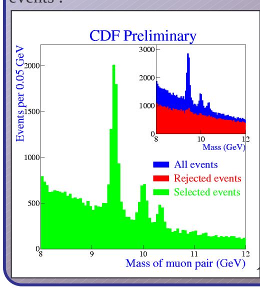
We take as the value of the scaling factor that that minimize the χ^2 of the fit. A typical result is:

Scale factor = 1.005 ± 0.003

The error on the scale is statistical only.

WY and ZY search in Run-I

We have performed a search for associated production of a Y(1s) particle and a vector boson in 83.4 pb^{-1} of Run Ib data collected by CDF with single muon and dimuon triggers. The process should yield far less than one event in the considered dataset, therefore the search is optimized for setting limits to the cross section. Four different signatures of the vector boson decay are searched: high-Pt electrons, high-Pt muons, significant missing Et, high-mass dijet pairs. Three events are observed in all the considered channels, with a total expected background of 3.5 ± 1.5 events .



The following results are obtained:

sigma(WY) B(Y -> mu mu) < 2.3 pb (95% C.L.).
sigma(ZY) B(Y -> mu mu) < 2.5 pb (95% C.L.).

The Figure shows a summary of the preliminary selection of events containing two good muon candidates in the Y mass region; the selection reduces the sample by a factor of 4.3 with an acceptance above 90% on the Y(1s) signal.